



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
**REGION 5**  
**77 WEST JACKSON BOULEVARD**  
**CHICAGO, IL 60604-3590**

**STATEMENT OF BASIS FOR ISSUANCE OF A CLASS VI UNDERGROUND INJECTION  
CONTROL (UIC) PERMIT**

**Permit Number: IL-115-6A-0002**

**Facility Name: CCS#1**

Archer Daniels Midland (ADM) of Decatur, Illinois applied for a U. S. Environmental Protection Agency (EPA) UIC Class VI permit to conduct geologic sequestration (GS) of carbon dioxide (CO<sub>2</sub>) at one well (CCS#1) at its Decatur, IL facility. ADM is capturing CO<sub>2</sub> at its agricultural and biofuels facility generated from a fuel ethanol production unit, which it is injecting underground to support the goal of reducing carbon emissions to the atmosphere to help mitigate climate change.

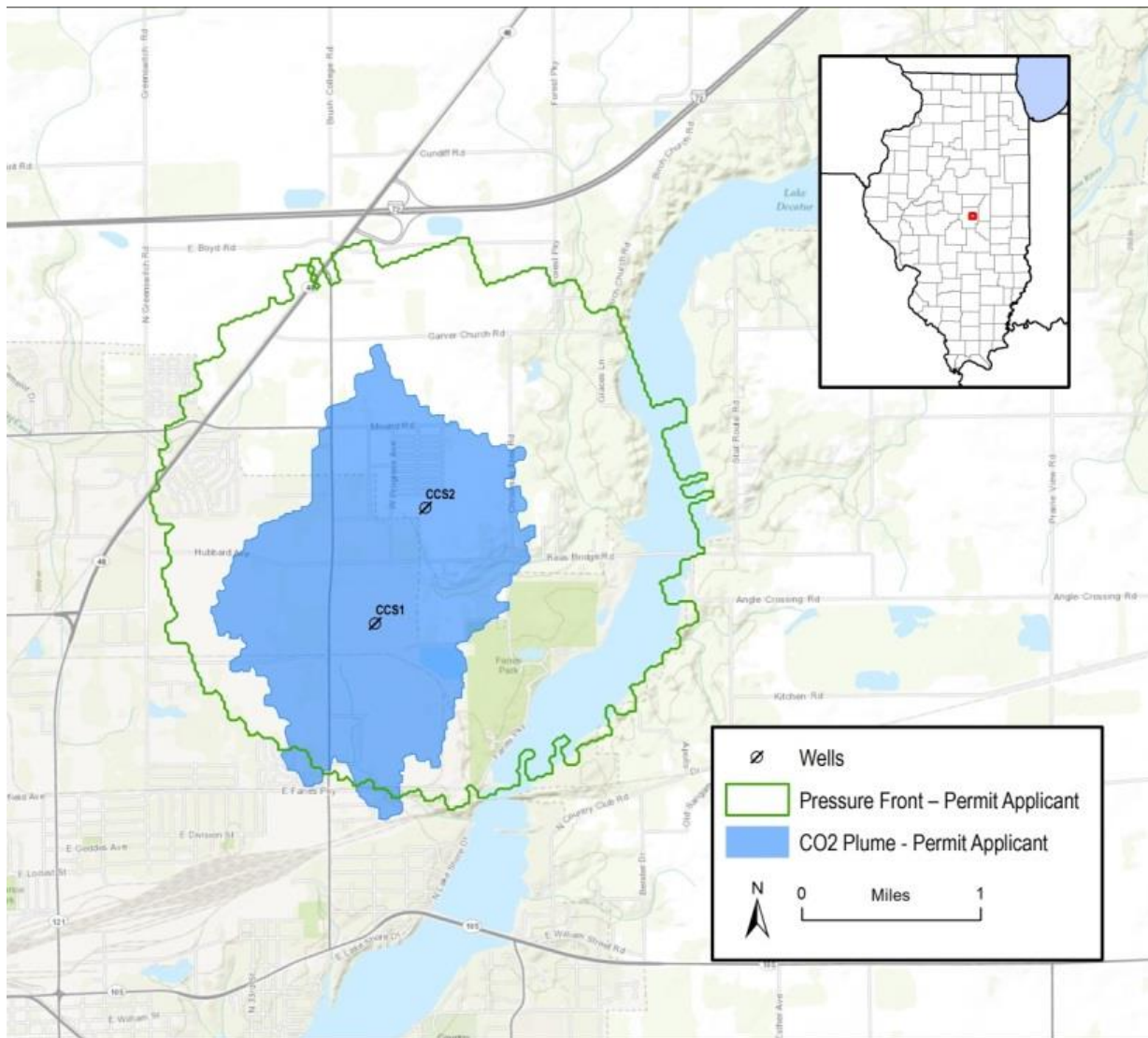
ADM has been injecting carbon dioxide at this well since 2011 under a Class I permit issued by the Illinois Environmental Protection Agency (Permit No. UIC-012-ADM). This permitting action is being taken to transfer regulatory authority from IEPA to the U.S. EPA. Additionally, on September 23, 2014, ADM received a Class VI permit to construct another well, CCS#2 (U.S. EPA Permit No. IL-115-6A-0001). When injection begins at CCS#2, the two wells will create a single carbon dioxide plume and pressure front. Activities under this permit will be performed in coordination with activities at CCS#2 to ensure that drinking water sources are protected and both wells are appropriately managed by ADM.

EPA reviewed all information submitted by ADM to inform the draft permit decision on CCS#1. EPA considered information and issues including:

- Geologic site characterization, injection and confining zone characterization, and project siting;
- Computational modeling of the project's Area of Review (AoR);
- The well's construction and site operations;
- The approach ADM proposed to monitor the well and track the plume and pressure front to ensure protection of underground sources of drinking water (USDWs) for the life of the project;
- ADM's financial responsibility demonstration;
- The strategy to address and mitigate risks associated with induced seismicity;
- The proposed alternative post-injection site care timeframe;
- Emergency and remedial response strategy development;
- The characteristics and purity of the injected carbon dioxide;
- Environmental justice;
- Endangered species; and
- Ensuring USDW protection.

EPA's review of the permit application indicates that the project meets the requirements for Class VI wells and will not pose a risk of endangerment to USDWs. EPA, therefore, is issuing a draft permit decision for this well. Under the authority of Title 40 of the Code of Federal Regulations (40 CFR) Parts 144 and 146, EPA Class VI permits must specify conditions for the construction, operation, monitoring, reporting, plugging, post-injection site care and site closure of Class VI injection wells so as to prevent the movement of fluids into any USDW or unauthorized zones. General provisions for EPA UIC permit requirements are found at 40 CFR Parts 124, 144, 146 and 147. In accordance with 40 CFR 124.7, general information and highlighted permit conditions specific to this well are discussed in the following sections.

**Area of Review (AoR) and Corrective Action:** In accordance with 40 CFR 144.55, 146.6, 146.7 and 146.84, the AoR is the region surrounding the geologic sequestration project where any improperly sealed, completed or abandoned wells that penetrate the injection and/or confining zones could provide a conduit for fluid migration. ADM delineated an AoR of approximately 2 square miles, as shown in the map below.



**Figure 1. The ADM project proposed AoR including: the modeled CO<sub>2</sub> plume (in blue) and the predicted area of elevated pressure (outlined in green).**

This area was delineated pursuant to 40 CFR 146.84(c)(1) using a computational model that predicts the movement of the carbon dioxide plume and pressure front based on available information about injection operations and the subsurface rock formations. EPA performed an extensive evaluation of the AoR proposed by ADM by independently modeling the AoR using the Subsurface Transport Over Multiple Phases (STOMP) multi-phase transport model, based on the site-specific geologic and operational data in the permit application and determined that the AoR delineated by ADM is sufficiently extensive and meets the requirements of 40 CFR 146.84(c)(1). EPA also evaluated the modeling approach used by the permittee and determined that it meets the requirements for computational models to delineate Class VI AoRs. Information about EPA's independent assessment is available in a report in the Administrative Record for this permit decision.

In accordance with 40 CFR 144.55 and 146.84, ADM must perform corrective action to address any deficiencies identified in wells in the AoR, as described in the Area of Review and Corrective Action Plan attached to the permit. Based on an evaluation of well records, ADM has determined that there are two active wells (the CCS#1 and a monitoring well, Verification Well #1) and no temporarily abandoned or plugged and abandoned wells within the AoR that penetrate the injection zone. EPA confirmed ADM's assessment of wells in the AoR by reviewing water well databases from the Illinois State Geological Survey and the Illinois State Water Survey, and confirmed that no wells in the AoR penetrate the confining zone and thus no wells require corrective action.

As required at 40 CFR 146.84(e), ADM will reevaluate the AoR using computational modeling at least every five years over the life of the project to verify, based on monitoring and operating data, that the carbon dioxide plume and pressure front are moving as predicted. ADM will also review monitoring data annually to determine whether additional reevaluations of the AoR are needed. This AoR reevaluation, and any additional corrective action that is needed, will be performed pursuant to the Area of Review and Corrective Action Plan, which is an enforceable condition of the Class VI permit. If this reevaluation indicates that there are changes from predictions, ADM must revise all of the project-specific plans and the permit will be modified per 40 CFR 144.39.

**Underground Sources of Drinking Water:** A USDW is defined by the UIC regulations as an aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/L total dissolved solids and is not an exempted aquifer. The base of the St. Peter Formation, the lowermost USDW in the vicinity of the well, has been identified at approximately 2,604 feet below the ground surface, based on potentiometric data collected from four ground water monitoring wells at the site. The shallow, Quaternary- and Pennsylvanian-age aquifers that serve as the source of local drinking water are approximately 140 feet below the ground surface.

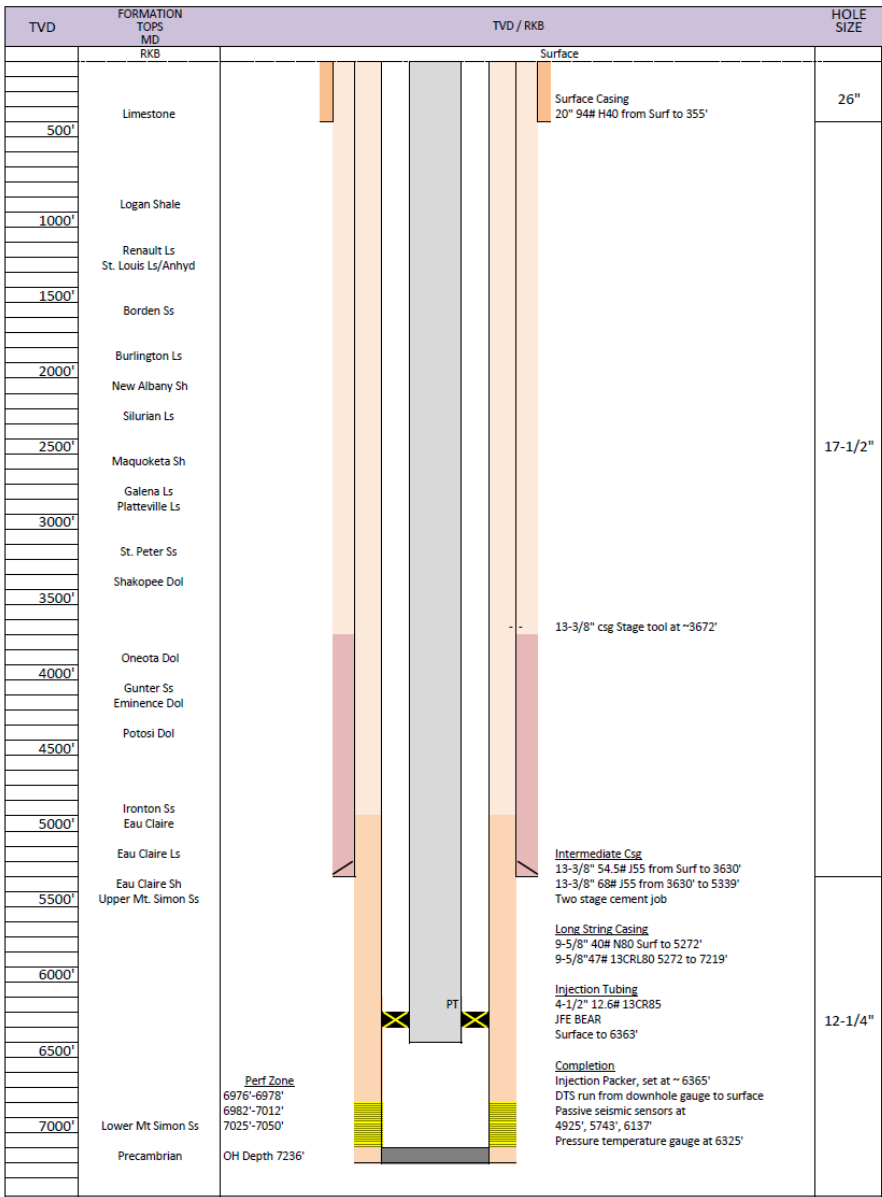
**Injection and Confining Zones:** The Mt. Simon Sandstone is the injection zone for this project, and carbon dioxide is being injected between 5,545 and 7,051 feet below the ground surface. This zone is separated from the lowermost USDW by approximately 2,941 feet of rock, including an impermeable confining zone, the Eau Claire Formation, which will act as barrier to fluid movement. Figure 2 shows the depth of the injection and confining zones.

EPA has reviewed extensive information submitted by ADM, including maps, well logs, cores, and the results of seismic surveys. Based on this information, EPA has determined that the regional and local geologic features at the site will allow the Mt. Simon Sandstone to receive and store the injected carbon dioxide without an excessive buildup of pressure that would create faults or fractures. EPA also determined that the site is free of any known faults or fractures that could affect containment and that the Eau Claire Formation will provide suitable containment to ensure that the carbon dioxide remains in place and USDWs will not be endangered, as required under 40 CFR 146.83. EPA also evaluated information on

seismic history in the area and seismic risk to conclude that the project poses a low risk of inducing felt seismic events. Information on this evaluation is available in a separate document in the Administrative Record for this permit decision.

**Construction Requirements:** The well, which was constructed in 2009, meets the regulatory criteria of 40 CFR 146.86. All Class VI wells must be constructed with carbon dioxide-compatible materials and cements that can withstand exposure to carbon dioxide and carbon dioxide/water mixtures without excessive corrosion over the life of the project (see Figure 2 for a construction schematic). EPA reviewed the final “as built” well schematics to verify that the cements and other materials used in the well are compatible with the carbon dioxide stream and site operations.

**ADM CCS#1 Well Schematic**  
(depths are reference to the Kelley bushing = 689 ft above MSL)  
KB = 15 ft above ground, site elevation = 674 ft above MSL



All casings are cemented to surface  
CO<sub>2</sub> resistant EverCRETE® was used for tail cement on long string job

Figure 2. Injection Well Schematic

**Injection Fluid:** Approximately 900,000 metric tons of 99 percent pure carbon dioxide has been injected since CCS#1 began operating in 2011. The source of the carbon dioxide is ADM's biofuel production facility. EPA evaluated historical information about the carbon dioxide generated by the ethanol plant provided by ADM and determined that the carbon dioxide generated is very pure and contains no hazardous constituents.

**Post-Injection Monitoring and Reporting Requirements:** In accordance with 40 CFR 146.90 and 146.93, ADM will implement post-injection testing and monitoring, as described in its approved Post-Injection Site Care and Site Closure Plan. The multi-faceted testing and monitoring provisions of this Plan, which is an enforceable condition of the Class VI permit, include the following activities that ADM will undertake to ensure USDW protection:

- Mechanical integrity testing in accordance with 40 CFR 146.8 and 146.89. ADM will be required to demonstrate the mechanical integrity of CCS#1 and all monitoring wells at the site every 5 years throughout the monitoring period. ADM must demonstrate internal mechanical integrity using a pressure test or casing inspection log to detect leaks in the casing, tubing or packer. In addition, ADM must demonstrate external mechanical integrity using a noise log, oxygen activation log, or another method approved by the Director to detect fluid movement behind the casing.
- Monitoring the environment near the well to verify that the project and the carbon dioxide plume and pressure front are behaving as predicted. (See the section entitled "Area of Review and Corrective Action" for details on the delineation of this area and Figure 1.) ADM will:
  - Perform groundwater quality monitoring in shallow wells quarterly from the time the permit is issued through the first two years of injection at CCS#2, and every 6 months after that, and monitor ground water quality in deeper wells annually to detect geochemical changes that may be a result of changes in the subsurface (such as leaching or mobilization of heavy metals and organic compounds or fluid displacement) that could impact USDWs.
  - Track the movement of the carbon dioxide plume and pressure front using direct methods (e.g., fluid sampling and pressure/temperature monitoring) and indirect methods (e.g., pulsed neutron capture/reservoir saturation logs and 3D seismic surveys) to verify that the carbon dioxide plume and pressure front are moving as predicted or provide early warning if they are not.
- Monitoring for natural or induced seismic events to verify that the project is operating as predicted and the geologic system and injection and monitoring wells are not compromised by any felt or unfelt microseismic events, whether natural or induced.

In accordance with 40 CFR 144.54 and 146.91, ADM will submit the results of this monitoring to the permitting authority annually or within 30 days of the completion of an MIT or other required testing.

EPA evaluated ADM's proposed post-injection testing and monitoring to ensure that all testing procedures are appropriate to the project and the geologic environment and that this testing and monitoring meets the requirements of the Class VI Rule at 40 CFR 146.90 and 146.93. EPA determined, based on information regarding the anticipated movement of the carbon dioxide plume and pressure front, that the locations and methods for monitoring ground water quality and the position of the plume and pressure front will provide the information needed to provide early warning of ground water quality changes or carbon dioxide leakage. EPA considered modeling data, hydrogeologic information on the properties of the injection and confining zone, and the need to limit the number of penetrations of the confining zone in determining the appropriate direct and indirect ground water and carbon dioxide monitoring regime.

**Emergency and Remedial Response:** In accordance with 40 CFR 146.94, ADM developed a site-specific Emergency and Remedial Response Plan that identifies the resources that may be at risk, including USDWs; drinking water wells; the Sangamon River; Bois Du Sangamon Nature Preserve; Lake Decatur; and infrastructure, including the wellhead, structures at Richland Community College, Heartland Community Church, residential areas, commercial properties, recreational facilities, and the ADM facilities. The Emergency and Remedial Response Plan, which is an enforceable part of the permit, also describes the responses that would be taken to address adverse events, and the staff and equipment available to support this and other such activities. The Emergency and Remedial Response provisions of the permit will facilitate expedient responses and prevent or mitigate harm to the environment, including USDWs. EPA evaluated the Emergency and Remedial Response Plan to verify that sufficient, specific procedures are in place should an adverse event (including a well failure, leakage of carbon dioxide, or a seismic event) that impacts any identified resource in the AoR arise so that ADM can expeditiously take effective actions to prevent or mitigate harm to USDWs.

**Financial Responsibility:** In accordance with 40 CFR 146.85, ADM has demonstrated and will maintain adequate financial resources to perform all needed corrective action on wells in the AoR, to plug the injection well, to perform all required post-injection site care activities and close the site, and to conduct any emergency and remedial response needed to address adverse events at the site. This financial responsibility ensures that resources are available to perform all USDW-protective activities without using public/taxpayer money. ADM estimated the costs necessary to cover the activities described above and provided financial statements and bond ratings to demonstrate that it has the necessary resources to cover these costs. ADM will update the cost estimates on an annual basis and, if necessary, adjust the financial responsibility demonstration to address any changes, e.g., based on inflation or changes to the project that affect these costs.

EPA determined that the amount of funds ADM has set aside is adequate by comparing cost estimates provided by ADM for the covered activities to estimates EPA independently generated using its Cost Estimation Tool, which estimates financial responsibility costs based on site-specific information (e.g., about well depth, the presence of USDWs in the AoR, and the volume of carbon dioxide injected). EPA also evaluated the financial responsibility instruments using checklists developed by the UIC Program that evaluate the strength of available instruments. Information on EPA's cost estimation analysis is documented in a report that is available in the Administrative Record for this permit decision.

**Well Plugging:** In accordance with 40 CFR 146.92, the permit includes a Well Plugging Plan for environmentally protective plugging of the injection well to ensure that the well will be plugged in a manner that will not allow movement of injected or native fluids into USDWs. After monitoring via CCS#1 is complete, the well will be plugged using approved materials that are compatible with carbon dioxide/water mixtures to ensure that it will not serve as a conduit for fluid movement. EPA evaluated ADM proposed Injection Well Plugging Plan to verify that the well will be plugged with sufficient numbers and types of plugs and cement, based on the depth and design of the well and geologic information, to ensure that after it is plugged, the well will not serve as a conduit for fluid movement. The Injection Well Plugging plan is an enforceable condition of the Class VI permit.

**Site Closure:** In accordance with 40 CFR 146.93, ADM must monitor ground water quality and track the movement of the carbon dioxide plume and pressure front as described under "Post-Injection Monitoring and Reporting Requirements" above. ADM will continue this post-injection monitoring for at least ten (10) years and until they can demonstrate that the site does not pose a risk of endangerment to USDWs and that site closure may be authorized. This timeframe differs from the 50-year default in the Class VI Rule, and is allowable if a permittee can demonstrate, based on significant, site-specific data and information about the site and the operation that the project will no longer pose a risk of endangerment to USDWs at the end of this alternative post-injection site care timeframe. In approving ADM's alternative post-

injection site care (PISC) timeframe, EPA considered information on the predicted movement of the carbon dioxide plume and pressure front, as informed by the AoR delineation modeling; predictions of plume migration, pressure decline, and carbon dioxide trapping; site-specific geology; well construction; and the distance between the injection zone and the nearest USDWs.

Post-injection monitoring must continue until ADM can successfully demonstrate that the site does not pose a risk to USDWs, based on site-specific information that is described in the Post-Injection Site Care and Site Closure Plan, which is an enforceable condition of the Class VI permit. This non-endangerment demonstration will be based on a comparison of monitoring data to model predictions and an evaluation of the carbon dioxide plume, mobilized fluids, reservoir pressure, and potential conduits for fluid movement.

Following authorization of site closure, ADM will plug all monitoring wells with carbon dioxide-compatible materials to ensure that they cannot serve as conduits for fluid movement and will restore the site to its original condition (by removing all equipment and planting vegetation).

**Issuance and Effective Date of Permit:** In accordance with 40 CFR 124.15, the permit will become effective immediately upon final issuance if no public comments are received during the public comment period that request a change in the draft permit. However, in the event that public comments are received that request a change in the draft permit, then the permit will become effective 45 days after the date of issuance unless the permit is appealed. In accordance with 40 CFR 144.36(a), the permit will be in effect for the life of the project, unless it is otherwise modified, revoked and reissued, or terminated as provided at 40 CFR 144.39, 144.40 and 144.41.

**Opportunity for Public Input:** Questions, comments and requests for additional information may be submitted in writing to Andrew Greenhagen at [Greenhagen.Andrew@epa.gov](mailto:Greenhagen.Andrew@epa.gov) via the internet. The public comment period on this permitting action will close on November 7, 2014, 37 days after the date of the public notice. During the comment period, EPA will also conduct a public hearing on November 5, 2014 at Decatur Public Library, 130 N. Franklin Street to facilitate submittal of verbal comments on this permit.

The administrative record index for this permit is available at [www.epa.gov/region5/water/uic/adm/](http://www.epa.gov/region5/water/uic/adm/). The full administrative record, including all data and information submitted by ADM in support of its permit application, is available for public review at EPA's Chicago regional office. The office is open 8:30 a.m.–4:30 p.m., weekdays.

To preserve your right to appeal any final permit decision that may be made in this matter under 40 CFR Part 124, you must either participate in the public hearing or send in written comments on the draft permit decision. The first appeal must be made to the Environmental Appeals Board; only after all agency review procedures have been exhausted may you file an action in the appropriate Circuit Court of Appeals for review.